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## Geologic Application of Thermal-inertia Mapping from Satellite

Type II Progress Report  
June - August 1979

(E80-10005) GEOLOGIC APPLICATION OF  
THERMAL-INERTIA MAPPING FROM SATELLITE  
Progress Report, 1 Jun. - 31 Aug. 1979  
(Geological Survey) 14 p HC A02/MF A0

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Prepared for  
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**TECHNICAL REPORT STANDARD TITLE PAGE**

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4. Title and Subtitle Geologic applications of thermal-inertia mapping from satellite		5. Report Date	
7. Author(s) Susanne H. Miller and Kenneth Watson		6. Performing Organization Code	
9. Performing Organization Name and Address U.S. Geological Survey Petrophysics and Remote Sensing Branch Box 25046 Federal Center, Stop 964 Denver, Colorado 80225		8. Performing Organization Report No.	
12. Sponsoring Agency Name and Address James C. Broderick HCMM Investigative Support Goddard Space Flight Center, Code 902.6 Greenbelt, Maryland 20771		10. Work Unit No.	
15. Supplementary Notes		11. Contract or Grant No.	
		13. Type of Report and Period Covered Type II Progress Report June 1 - August 31, 1979	
		14. Sponsoring Agency Code	
16. Abstract  A topographically registered thermal-inertia image was constructed using USGS aircraft data. The image is centered on a latitude of 43°27' and extends from 105°29' to 105°35' longitude with a swath width of 7 km.			
REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR			
17. Key Words (Selected by Author(s))	18. Distribution Statement		
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**Figure 2. Technical Report Standard Title Page**

#### A. Problems

The HCMM data products received include 153 black and white screening prints, one useable night thermal CCT over the Powder River Basin, WY, and one day thermal and visible CCT over Cabeza Prieta in Arizona. We have not received a day/night data set pair (CCTs) with which to conduct our thermal-inertia investigation.

#### B. Accomplishments

USGS scanner data, on an east/west line of latitude 43°27', were digitized from 105°29' to 105°35' longitude. These data represent the segment directly west of the thermal-inertia image constructed during the last reporting period. This new data segment was processed in similar manner, and a relative thermal-inertia image was constructed from the products. This relative image was registered to a topographic base and is in the process of being concatenated to the eastern thermal-inertia image.

CCTs from two different scenes were received during this period and reformatted to be compatible with the USGS Honeywell computer. One scene was a nighttime thermal image of the Powder River Basin, WY site. The other was a daytime thermal and visible pair of the Cabeza Prieta area in Arizona. We are awaiting the corresponding CCTs which will complete the day/night pair for each scene.

We are investigating using data over large water bodies to determine the magnitude of the atmospheric attenuation/emission effect. This technique has been applied to the aircraft data with considerable success. The major limitation appears to be the availability of water bodies of sufficient size. It was determined that the scan angle across the Great Salt Lake does not change significantly enough to calculate an extrapolated surface temperature within acceptable error limits. This method does not appear promising for atmospheric calibration of satellite thermal data.

#### C. Significant Results

The significant results from this report period are: constructed topographically registered relative thermal-inertia image of a portion of the Powder River Basin, WY, using USGS aircraft data. This segment is directly west of the image constructed during the last reporting period.

For further details, see the accomplishment section.

#### D. Publications and Presentations

Ken Watson was an invited speaker at the Gordon Research Conference held August 20-24, at Plymouth, NH. The title of the conference was "Remote Sensing of the Earth's Surface".

#### E. Recommendations

None

**F. Funds Expended**

**Total expenditures to date: \$71,838**

**G. Data Utility**

**A list of the HCMM data products received to date is submitted with this report.**

## SITE: Wyoming - Powder River Basin

DATE: May/June 1978

## HCMN DATA PRODUCTS

Date	Data	Product	% Sites Covered						% Site Covered			DN Range			Ratings			Pairs?		Scene ID		Remainder				
			Day Vis	Day Ir	Nite	IR	B&W	Trans	CCT	<10	10	25	50	75	100	<10	30	60	90	Low	High	Unsat	Mar	Sat	Yes	No
5/11	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0015-20220-1	RMS 277
6/8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0043-20450-1	NW section
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0043-20450-2	-do-
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0043-20430-1	SW section
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0043-20430-2	-do-
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0043-09480-3	NW tip
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0043-09490-3	SW tip, good image of Salt Lake
6/11	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0046-20020-1	NE section
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0046-20020-1	-do-
6/12	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0047-20190-1	SE corner
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0047-20190-2	-do-
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0047-20200-1	Northern 75%
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0047-20200-2	-do-
6/17	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0052-20120-2	SE tip
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0052-20130-1	SE section
6/18	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0052-20130-2	-do-
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0053-20310-1	
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0053-20310-2	
6/28	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0063-20170-1	Southern end
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0063-20170-2	-do-
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0063-20190-1	Northern half
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0063-20190-2	-do-
6/29	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0064-09390-3	NW tip

## SITE: Wyoming - Powder River Basin

## HCMW DATA PRODUCTS

DATE: July 1978

Date	Data	Product	% Site Covered			% Site Covered			DN Range			Ratings			Pairs?		Scene ID	Remarks				
			Day Vis	Day Ir	Nite IR	B&W Trans	CCT	<10	10	25	50	75	100	<10	30	60	90	Low	High	Unsat	Mar	Set
7/2	x	x	x	x	x	x	x	x	x	x	x	x	x	7	133	x	x	x	x	0067-19540-2	NE corner	-do-
7/8	x	x	x	x	x	x	x	x	x	x	x	x	x	15	168	x	x	x	x	0067-19540-1	NE corner	-do-
7/13	x	x	x	x	x	x	x	x	x	x	x	x	x	17	202	x	x	x	x	0073-20050-1	SE corner	-do-
7/18	x	x	x	x	x	x	x	x	x	x	x	x	x	16	146	x	x	x	x	0078-19570-1	NE corner	-do-
7/20	x	x	x	x	x	x	x	x	x	x	x	x	x	13	131	x	x	x	x	0078-19570-2	NE quad	-do-
7/24	x	x	x	x	x	x	x	x	x	x	x	x	x	4	64	x	x	x	x	0078-09020-3	NE quad	-do-
7/25	x	x	x	x	x	x	x	x	x	x	x	x	x	11	192	x	x	x	x	0083-19510-1	NE quad	-do-
7/30	x	x	x	x	x	x	x	x	x	x	x	x	x	3	151	x	x	x	x	0083-19510-2	NE quad	-do-
														2	55	x	x	x	x	0085-09290-3	NW tip	Missing SE part
														2	76	x	x	x	x	0085-09310-3	NW tip	Missing SE part
														9	68	x	x	x	x	0089-09060-3	No western edge	-do-
														24	54	x	x	x	x	0089-20010-1	No western edge	-do-
														32	169	x	x	x	x	0089-20010-2	No western edge	-do-
														2	64	x	x	x	x	0090-09230-3	SW corner	-do-
														4	72	x	x	x	x	0090-09250-3	SW corner	-do-
														6	56	x	x	x	x	0095-0170-3	Good data, possibly meteorologically anomalous	-do-
														12	209	x	x	x	x	0095-20110-1	SE tip	-do-
														4	145	x	x	x	x	0095-20110-2	SE tip	-do-
														12	172	x	x	x	x	0095-20130-1	Missing SZ tip	-do-
														3	136	x	x	x	x	0095-20130-2	Missing SZ tip	-do-

## SITE: Wyoming - Powder River Basin

DATE: August 1978

## HCMN DATA PRODUCTS

Date	Data	Product	Site Covered						Cloud Covered	DN Range	Ratings	Pairs?	Scene ID	Remarks	
			Day Vis	Day Ir	Nite	IR	B&W Trans	CCT							
8/5	x	x	x	x	x	x	x	x	x	13 16	61 79	x	x	0101-09270-3 0101-09280-3	Very clear SW tip, clear over Salt Lake
8/10	x	x	x	x	x	x	x	x	x	3 4	76 68	x	x	0106-09210-3 0106-09200-3	SW tip
8/15	x	x	x	x	x	x	x	x	x	1	45	x	x	0111-09120-3	No. half, clear only near Sheridan
	x	x	x	x	x	x	x	x	x	1 15 6 11	51 172 154 155	x	x	0111-09140-3 0111-20080-1 0111-20080-2 0111-20090-1	SW tip only So. boundary -do-
	x	x	x	x	x	x	x	x	x	5	121	x	x	0111-20090-2	
8/19	x	x	x	x	x	x	x	x	x	4	61	x	x	0115-084/0-3	Barely gets the E edge
	x	x	x	x	x	x	x	x	x	2	58	x	x	0115-08480-3	Only gets the SE tip
8/25	x	x	x	x	x	x	x	x	x	2	224	x	x	0121-19550-1	Data not cloud covered, had noise problems -do-
	x	x	x	x	x	x	x	x	x	7	189	x	x	0121-19550-2	
8/31	x	x	x	x	x	x	x	x	x	2 15 16 2	138 191 170 125	x	x	0127-20060-2 0127-20060-1 0127-20070-1 0127-20070-2	No. border -do-

## SITE: Wyoming - Powder River Basin

## HCMN DATA PRODUCTS

DATE: September 1978

Date	Data	Product	% Site Covered						% Site Covered			DN Range			Ratings			Pairs?		Scene ID		Remarks			
			Day Vis	Day Ir	Nite IR	B&W Trans	CCT	<10	10	25	50	75	100	<10	10	30	60	90	Low	High	Unsat	Mar	Sat	Yes	No
9/5	x	x	x	x	x	x	x	x	x	x	x	x	x	3	71	x	x	x	x	x	0132-09030-3	0132-09050-3	No. border	Very clear	
	x	x	x	x	x	x	x	x	x	x	x	x	x	15	72	x	x	x	x	x	0132-19590-1	0132-19590-2	SE area	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	23	49	x	x	x	x	x	0132-29010-1	0132-29010-2	Large data dropout in northern part of site	Clouds may be problem in day	
	x	x	x	x	x	x	x	x	x	x	x	x	x	13	152	x	x	x	x	x	0132-20010-2	0132-20010-3	Clouds may be problem in day	Clouds may be problem in day	
9/6	x	x	x	x	x	x	x	x	x	x	x	x	x	2	145	x	x	x	x	x	0133-09220-3	0133-09230-3	No. half So. half, missing	eastern part	
9/10	x	x	x	x	x	x	x	x	x	x	x	x	x	2	74	x	x	x	x	x	0137-19530-2	0137-19530-1	SE quarter	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	3	72	x	x	x	x	x	0137-19530-1	0137-19530-1	SE quarter	-do-	
9/26	x	x	x	x	x	x	x	x	x	x	x	x	x	1	24	x	x	x	x	x	0153-08560-3	0153-08580-3	NE quarter	Very good, RMS 281	
	x	x	x	x	x	x	x	x	x	x	x	x	x	1	26	x	x	x	x	x	0153-19530-1	0153-19530-2	SE quarter	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	1	77	x	x	x	x	x	0153-19540-1	0153-19540-2	NE portion	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	10	96	x	x	x	x	x	0153-19540-2	0153-19540-2	NE portion	-do-	
9/27	x	x	x	x	x	x	x	x	x	x	x	x	x	1	133	x	x	x	x	x	0154-09140-3	0154-09160-3	No. border	Very good, RMS 283	
	x	x	x	x	x	x	x	x	x	x	x	x	x	10	41	x	x	x	x	x	0154-09160-3	0154-09160-3	No. border	Very good, RMS 283	
	x	x	x	x	x	x	x	x	x	x	x	x	x	12	43	x	x	x	x	x	0154-20100-1	0154-20100-2	So. edge	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	4	39	x	x	x	x	x	0154-20100-1	0154-20100-2	So. edge	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	41	68	x	x	x	x	x	0154-20100-1	0154-20100-2	So. edge	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	2	25	x	x	x	x	x	0154-20100-1	0154-20100-2	So. edge	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x	39	64	x	x	x	x	x	0154-20100-1	0154-20100-2	So. edge	-do-	
	x	x	x	x	x	x	x	x	x	x	x	x	x								0154-20100-1	0154-20100-2	So. edge	-do-	

## SITE: Wyoming - Powder River Basin

## ROCM DATA PRODUCTS

DATE: October 1978

Date	Data	Product	Site Covered						Site Cloud Covered			DN Range	Ratings	Pairs?	Scene ID	Remarks									
			Day	Day	Nite	IR	B&W	Trans	CCT	<10	10	25	50	75	100	<10	30	60	90	Low	High	Unsat	Mar	Sat	Yes
10/13	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	26	x	x	x	x	x	x	x	0160-09260-3 0160-09280-3
10/16	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	45	x	x	x	x	x	x	x	NW tip SW tip
10/17	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	40	x	x	x	x	x	x	x	0163-08430-3
10/19	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	44	51	x	x	x	x	x	x	x	0164-19570-1 0164-19570-2 -do-
10/23	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	12	57	x	x	x	x	x	x	x	0180-19540-1
10/24	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	89	x	x	x	x	x	x	x	0180-19540-2
10/28	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	58	112	x	x	x	x	x	x	x	0181-09160-3 0181-20120-1 0181-20120-2
10/29	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	29	x	x	x	x	x	x	x	0186-09050-3 0186-09100-3
10/30	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	26	x	x	x	x	x	x	x	0187-09260-3 NW tip

HECIMI DATA PRODUCTS

## SITE: Laramie - Boulder River Basin

DATE: November 1078

SITES: Wyoming - Powder River Basin																							
Date	Data		Product			% Site Covered			% Site Cloud Covered		DN Range	Ratings	Pairs?	Scene ID	Remarks								
	Day vis	Day IR	Nite IR	B&W	Trans	CCT	<10	10	25	50	75	100	<10	30	60	90	Low	High	Unsat	Mar	Sat	Yes	No
11/13	x	x	x				x	x					2	37	x	x	0191-09010-3	Image entirely black, may be snow covered					
11/14	x	x	x				x	x					2	7	x	x	0202-09050-3	Only water visible, rest of image black So. border -do- May be snow covered?					
11/15	x	x	x				x	x					15	119	x	x	0202-20100-1	NW portion, looks like snow -do-					
11/23	x	x	x	x	x	x	x	x	x	x	x	x	2	10	x	x	0211-08340-3	NE tip, very cold? SE tip, very cold?					
11/24	x	x	x	x	x	x	x	x	x	x	x	x	2	10	x	x	0212-08530-3	Very cold? -do-					
11/25	x	x	x				x	x					2	14	x	x	0213-09110-3	Very cold?					

## SITE: Wyoming - Powder River Basin

## HCMH DATA PRODUCTS

DATE: April 1979

Date	Data	Product	% Site Covered						% Site Covered			DN Range			Rating*			Pairs?	Scene ID	Remarks				
			Day Vis	Day Ir	Nite IR	B&W Trans	CCT	<10	10	25	50	75	100	<10	30	60	90	Low	High	Unsat	Mar	Set	Yes	No
4/1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	48	175	x	x	x	x	0340-19310-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	121	x	x	x	x	0340-19310-2
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	37	149	x	x	x	x	0340-19330-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	118	x	x	x	x	0340-19330-2
																								Av. scene temp. about 260°K
4/17	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	21	182	x	x	x	x	0356-19220-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	111	x	x	x	x	0356-19220-2
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	17	161	x	x	x	x	0356-19310-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	99	x	x	x	x	0356-19310-2

## SITE: Arizona - Cabeza Prieta

## RCRN DATA PRODUCTS

DATE: May and August 1978

Date	Data	Product	Z Site Covered	Z Site Cloud Covered	DN Range	Ratings	Pairs?	Scene ID	Remarks	
	Day Vis	Day Ir	B&W Trans	CCT	<10 10 25 50 75 100	10- <10 30 60 90	Low High	Uneat Mar Sat	Yes No	AA Number
5/30	x	x	x	x	x	x	x	x	x	0034-21130-1
6/2	x	x	x	x	x	x	7 2	208 136	x	0038-21030-1
6/5	x	x	x	x	x	3	89	x	x	0101-09300-3
6/7	x	x	x	x	x	2	74	x	x	0101-09320-3
6/10	x	x	x	x	x	8	156	x	x	0103-20550-1
6/17	x	x	x	x	x	1 24	155 183	x	x	0103-20550-2 0103-20570-1
6/28	x	x	x	x	x	1	1,5	x	x	0103-20570-2
						2	82	x	x	0106-09230-3
						14 3	194 157 90	x	x	0113-20420-1 0113-20420-2 0113-09520-3
										Eastern half -do- Ground track must have been off to get this. It isn't Aug. 17!
						8 5	180 188	x	x	0124-20460-1 0124-20460-2

## HCRN DATA PRODUCTS

SITE: Arizona - Cabeza Prieta

DATE: September 1978

Date	Data	Product	% Site Covered		% Site Cloud Covered		DN Range			Rating		Pairs?	Scene ID	Remarks						
			Day Vis	Nite Ir	10	25	50	75	100	<10	30	60	90	Low	High	Unsat	Mar	Sar	Yes	No
9/1	x	x	x	x	x	x	x	x	x	x	x	x	x	8	182	x	x	x	x	0130-20570-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	1	143	x	x	x	x	0130-20570-2 -do-
9/6	x	x	x	x	x	x	x	x	x	x	x	x	x	10	87	x	x	x	x	0133-09250-3
	x	x	x	x	x	x	x	x	x	x	x	x	x	3	88	x	x	x	x	0133-09270-3
9/14	x	x	x	x	x	x	x	x	x	x	x	x	x	4	161	x	x	x	x	0141-21030-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	31	144	x	x	x	x	0141-21030-2 -do-
	x	x	x	x	x	x	x	x	x	x	x	x	x	9	195	x	x	x	x	0141-21050-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	2	131	x	x	x	x	0141-21050-2 -do-
9/18	x	x	x	x	x	x	x	x	x	x	x	x	x	1	66	x	x	x	x	0145-09490-2
	x	x	x	x	x	x	x	x	x	x	x	x	x	39	68	x	x	x	x	0145-09500-3
	x	x	x	x	x	x	x	x	x	x	x	x	x	11	113	x	x	x	x	0145-20390-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	4	150	x	x	x	x	0145-20390-2 -do-
9/27	x	x	x	x	x	x	x	x	x	x	x	x	x	25	82	x	x	x	x	0154-09190-3
9/30	x	x	x	x	x	x	x	x	x	x	x	x	x	3	165	x	x	x	x	0157-21020-1
	x	x	x	x	x	x	x	x	x	x	x	x	x	3	158	x	x	x	x	0157-21020-2 -do-

SITE: Arizona - Cabeza Prieta

## HC-4 DATA PRODUCTS

DATE: March and April 1979

Date	Product						% Site Covered			% Site Covered			DN Range			Ratings			Pairs?		Scene ID		Remarks		
	Day Vis	Day Ir	Nite Ir	B&W	Trans	CCT	<10	10	25	50	75	100	<10	30	60	90	Low	High	Unsat	Mar	Sat	Yes	No	AA Number	
3/31	x	x	x	x			x						x				4	129	x			x		0339-20470-1	SW tip, clear over Salton Sea -do-
	x	x	x	x	x		x						x				27	129	x			x		0339-20470-2	
4/15	x	x	x	x	x		x	x	x	x	x	x	x	x	x	6	113	x	x	x	x	x	0354-20270-1		
																6	164							0354-20270-2	